NEW ORLEANS FORECAST DISTRICT.

Quiet weather conditions prevailed and no storm warnings were issued or required. Small-craft warnings, displayed on the central coast of Texas on the 9th, were justified.—*R. A. Dyke.*

DENVER FORECAST DISTRICT.

No special warnings were required or issued during the month, except fire-weather warnings which were distributed for the entire district on the evening of the 7th, when an area of low barometric pressure of considerable intensity was central in Montana and northern Idaho. On the morning of the 8th a maximum wind velocity of 42 miles per hour was reported at El Paso, and on the evening of the same date 30 miles at Albuquerque and 44 miles per hour at Cheyenne. The highest wind velocities for the month at Denver and Grand Junction, 38 miles per hour, also occurred on the 8th.—*Frederick W. Brist.*

SAN FRANCISCO FORECAST DISTRICT.

All storms from the North Pacific during the month moved inland at a high latitude and did not materially affect the weather in this district.

Thunderstorms occurred in the Sierra Nevada and Plateau region from the 4th to the 6th, and again from the 17th to the 23d.

On the 2d the temperature at Roseburg, Oreg., reached 104°, equaling the record for the month at that station.

A peculiar feature of the month was the absence of northwesterly gales along the central California coast. Usually these are of nearly daily occurrence at Point Reyes, but this month, instead of strong northwesterly gales, light south to southwest winds prevailed for days at a time. The observer informed me he could find no similar record for so many consecutive days in July.

Fire-weather warnings were issued in northern California on the 14th and 26th, and were verified.—*G. H. Willson.*

## RIVERS AND FLOODS.

By H. C. FRANKENFIELD, Meteorologist.

Moderate floods occurred in the rivers of the South Atlantic States on account of frequent rains after the middle of the month. Warnings were issued wherever and whenever necessary, and no damage of consequence resulted. There were no other floods east of the Mississippi River except a short and harmless one in the upper Connecticut River on July 2. There were, however, several overflows of small streams at different times caused by torrential local rains. These occurred in Southern New England and the Middle Atlantic States, and the aggregate losses were more than $1,000,000, mostly in northeastern Pennsylvania, where the storm was the fourth destructive one within four weeks.

The destructive floods of the month occurred in the rivers of northwest Missouri, where all the rivers and smaller streams overflowed their banks after the torrential rains of July 9 and 10. At Maryville 10.82 inches of rain fell during the 24 hours ending at 7 a. m. July 10, at Chillicothe 5.18 inches fell on July 9 and 10, and at Brunswick 3.34 inches on the same dates.

The larger rivers that were in flood were the Grand, Nishnabotna, Nodaway, One Hundred and Two, and Platte, and it was reported that the latter was 1½ miles in width in places on July 12.

Crops suffered enormously, bridges and roads were washed away, railroad tracks were torn up, and traffic generally interrupted. Between 8,000 and 10,000 acres of farm lands were inundated, and the losses will run into millions of dollars. The losses from the Grand River flood alone were reported as having been about $2,000,000.

Warnings were sent out on July 10 as soon as the first reports of heavy rain had been received, but, although the flood conditions did not become serious until early morning of July 12, many farmers were unable to get their wheat out of the lowlands. Some worked all day and throughout the night and succeeded in saving a considerable quantity of wheat, but many thousands of bushels were carried down the swollen rivers. It was impossible to convince numbers of farmers that a destructive flood could occur in July, and these lost everything. However, as a whole, both farmers and others were quick to action as soon as the warnings had been received, and many have expressed their gratitude and thanks for the timely and accurate warnings, which were distributed largely by telephone. By 9:40 a. m. July 10, or within one hour after the warnings had been received at the Weather Bureau Office at St. Joseph, they had been repeated to more than 100 farmers living in the One Hundred and Two River Valley in Andrew, Buchanan, and Platte Counties.

The following report on the flood in the Grand River of Missouri was prepared by Mr. M. W. Hayes, meteorologist in charge of the Weather Bureau Office, St. Louis, Mo.:

THE GRAND RIVER FLOOD OF JULY, 1922.

The basin of the Grand River extends from south central Iowa southward to the Missouri River. It is a comparatively flat area, containing 7,891 square miles and sloping from an elevation of about 1,000 feet above mean sea level in Iowa to about 700 feet at Chillicothe and about 650 feet at the mouth of the river. There are two distinct subbasins extending as far southward as Chillicothe: the easterly one contains 2,194 square miles and is of an elongated shape; the distance from Chillicothe to its upper end in Iowa is 125 miles. The westerly subbasin has an area of 2,664 square miles, while the distance from Chillicothe northwestward to its upper extremity is 20 miles less than the length of the easterly division. These two subbasins combined form an area that is almost rectangular except for an acute angle—the upper part of the easterly division—that extends well up into Iowa. Chillicothe is in the southeastern corner of the area.

Rainfall in extreme northern Missouri and south central Iowa is at times unusually excessive in periods varying in duration from two or three days to a week between May 15 and July 15. From 1909 to 1922, inclusive, there have been five years (1909, 1915, 1917, 1919, and 1922) in which rainy periods have given precipitation ranging in amount from 4 to 12 inches over a large part of the watershed above Chillicothe.

In comparing flood heights in the Grand below Chillicothe the influence of the Missouri River has to be considered, for a high Missouri checks the discharge of the lower Grand, while a low Missouri permits a rapid discharge and cuts the flood height in the lower river very materially. For purposes of comparison the Chillicothe stages alone are considered. The Chillicothe gauge is a very short distance below the confluence of the east and west branches of the river and is too far away from the mouth of the main stream to be affected in any material way by Missouri River stages.

The highest flood known in the Grand and its two principal tributaries that meet at Chillicothe occurred in July, 1909. In that year a period of rains began on July 5 and continued at an excessive rate for three days. In most of the drainage basin above Chillicothe 4 to 11 inches of rain fell.

The second highest flood was in June, 1917. The rain that caused it began on June 1 and, with the exception of the 3d, fell daily through the 6th. The amounts ranged from 4.34 to 7.47 inches. As in the case of the 1909 flood, the heaviest rain was a short distance south of the Iowa line, and the lightest was in the lower part of the drainage area.

The third highest was in July, 1922. The rainfall had been deficient since the latter days of May, and both the Grand River system and the Missouri River were low on July 9, when excessive rains began over the northwestern part of the Grand River basin. In less than 24